Executive Overview
Kentucky Climate Action Plan

Background

In November 2008, Governor Steven Beshear issued a report entitled *Intelligent Energy Choices for Kentucky's Future: Kentucky's 7-Point Strategy for Energy Independence*.[1] One of the provisions of the 7-Point Energy Strategy is to mitigate carbon dioxide (CO_2) emissions and to reduce Kentucky's carbon footprint. Development of the Climate Action Plan for Kentucky is aimed at furthering this objective to reduce Kentucky's carbon footprint. The Climate Action Plan has been built upon selected provisions of the Kentucky Energy Strategy. It also focuses attention on creating opportunities to build on Kentucky's progress to date to become more energy efficient, to reduce dependence on foreign oil, to enhance the nation's energy security, to promote new energy-related technologies, and to enhance economic opportunities in Kentucky.

The Kentucky Climate Action Plan process was convened in January 2010. The Council (KCAPC) overseeing the process consisted of a broad coalition of 27 members, including stakeholders from the business, academic, government, nonprofit, and environmental sectors, as well as individual citizens. The KCAPC was charged with producing a greenhouse gas (GHG) emissions inventory and forecast (I&F), compiling a comprehensive Climate Action Plan with recommended GHG reduction goals and potential actions to mitigate climate change and improve energy efficiency in various sectors of the economy, and advising state and local governments on measures to address climate change. The KCAPC held six in-person meetings and one teleconference meeting.

To provide a broad range of technical expertise and stakeholder involvement in development of the Climate Action Plan, the Secretary of the Energy and Environment Cabinet (KEEC) and the KCPAC also formed five Technical Work Groups (TWGs) to assist in the process. The five TWGs considered information and potential options in the following sectors:

- Energy Supply (ES);
- Residential, Commercial, and Industrial (RCI);
- Transportation and Land Use (TLU);
- Agriculture, Forestry, and Waste (AFW); and
- Cross-Cutting Issues (CCI) (i.e., issues that cut across the above sectors).

The Center for Climate Strategies (CCS) provided technical and facilitation support to KEEC and the KCAPC in formulating the Kentucky Climate Action Plan. The TWGs served as advisors to the KCAPC and consisted of KCAPC members and additional individuals with expertise in their respective sectors. Members of the public were invited to observe and provide input at all meetings of the KCAPC and TWGs. The TWGs assisted the KCAPC by generating initial Kentucky-specific policy options to be added to a catalog of existing state actions;

[1] Governor Steven Beshear, *Intelligent Energy Choices for Kentucky's Future: Kentucky's 7-Point Strategy for Energy Independence*, November 2008.

developing priority policy options for analysis; drafting proposals on the design characteristics and quantification of the proposed policy options; reviewing specifications for analysis of draft policy options (including best available data sources, methods, and assumptions); and evaluating the other key elements of policy option proposals, including related policies and programs, key uncertainties, co-benefits and costs, feasibility issues, and potential barriers to consensus.

Key Elements and Recommendations

The KCAPC developed this Climate Action Plan, which includes, but is not limited to, the following key elements and recommendations:

- The KCAPC's proposed GHG reduction goals for Kentucky are to achieve a 20% reduction of GHGs below 1990 levels by 2030 (from about 136.7 to 109.4 million metric tons of carbon dioxide equivalent [$MMtCO_2e$]). The KCAPC also recommends that energy efficiency and energy intensity goals, targets, and metrics be developed for the major sectors of the Commonwealth's economy over the next several years. These goals were developed taking into account Governor Steven Beshear's report *Intelligent Energy Choices for Kentucky's Future: Kentucky's 7-Point Strategy for Energy Independence*.
- The KCAPC approved a package of 46 multi-sector policy recommendations to reduce GHG emissions and address related energy and commerce issues in Kentucky. Of the 46 policy recommendations, 33 were analyzed quantitatively to have the effect of reducing GHG emissions by about 63.7 $MMtCO_2e$ in 2020 and 128.3 $MMtCO_2e$ in 2030, and a cumulative GHG emissions reduction of 1,316 $MMtCO_2e$ over the 2011–2030 period.
- The KCAPC-approved policy recommendations are projected to have a net cost of about $11.6 billion during the period 2011–2030. The weighted-average cost-effectiveness of these policies is estimated to be approximately $\$8.80/tCO_2e$.
- The KCAPC work included development of the first comprehensive, statewide GHG emissions I&F report for Kentucky for the period 1990–2030.

The data and costs presented in this report are based on the information and assumptions available at the time of analysis during 2010 and 2011. It is acknowledged that these recommendations may require updated data and further review and analysis prior to implementation. It is also acknowledged that many of these recommendations would require action by other entities, such as the Kentucky General Assembly and/or the Kentucky Public Service Commission.

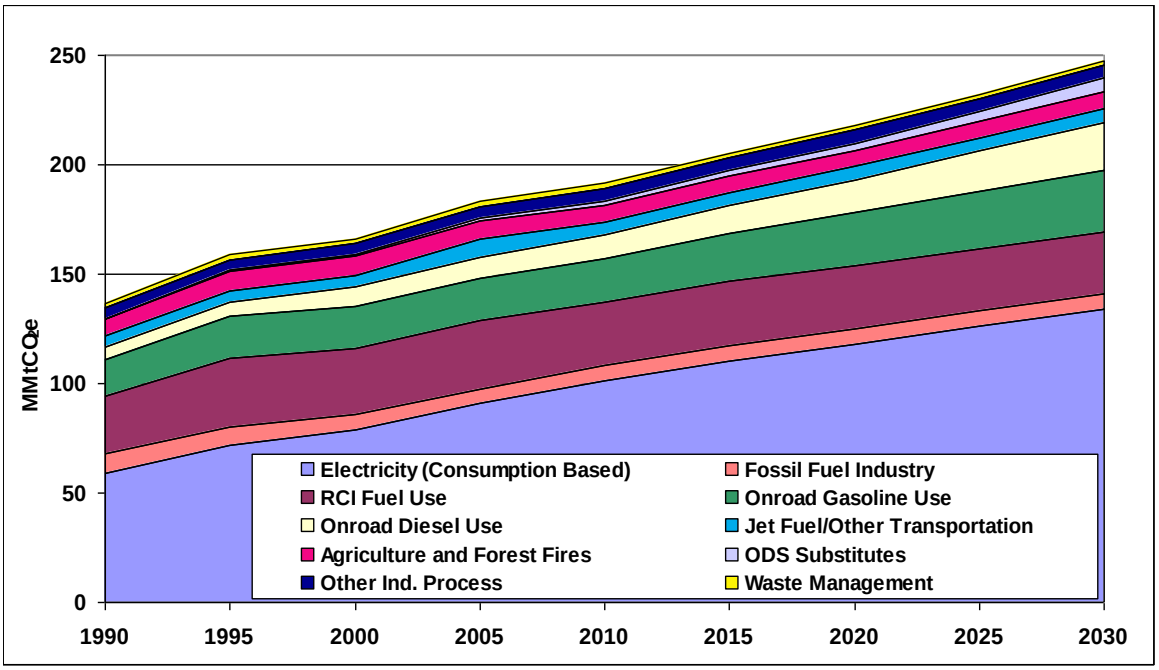
Kentucky GHG Emissions Inventory and Reference Case Projections

CCS prepared the Kentucky I&F report for the KEEC. The report presents an assessment of Kentucky's GHG emissions and anthropogenic sinks (carbon storage) from 1990 to 2030. The final I&F report, which was approved by the KCAPC at its meeting on June 2, 2010, is summarized in Chapter 2 of this report and is available in its entirety at: http://www.kyclimatechange.us/ewebeditpro/items/O122F23537.pdf. It is important to note that the analysis was done during 2009–2010, and recent announcements by utilities and more recent actions by the U.S. Environmental Protection Agency are not included in the 2010 I&F report.

The inventory and reference case projections cover the six types of gases included in the U.S. Greenhouse Gas Inventory: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). Emissions of these GHGs are presented using a common metric—CO_2 equivalence (CO_2e)—that indicates the relative contribution of each gas, per unit mass, to global average radiative forcing on a global warming potential (GWP)-weighted basis.[2]

The inventory and reference case projections revealed substantial emission growth rates and related mitigation challenges. Figure ExO-1 shows the reference case projections for Kentucky's gross GHG emissions as rising fairly steeply to 247.7 $MMtCO_2e$ by 2030, growing by 81% over 1990 levels. The figure also provides the breakdown of projected GHG emissions by sector.

Figure ExO-1. Gross GHG Emissions by Sector, 1990–2030: Historical and Projected (Consumption-Based Approach) Business-as-Usual/Base Case



[2] Changes in the atmospheric concentrations of GHGs can alter the balance of energy transfers between the atmosphere, space, land, and oceans. A gauge of these changes is called radiative forcing, which is a simple measure of changes in the energy available to the Earth-atmosphere system. Holding everything else constant, increases in GHG concentrations in the atmosphere will produce positive radiative forcing (i.e., a net increase in the absorption of energy by the Earth)., See: Boucher, O., et al. "Radiative Forcing of Climate Change." Chapter 6 in *Climate Change 2001: The Scientific Basis*. Contribution of Working Group 1 of the Intergovernmental Panel on Climate Change. Cambridge, United Kingdom: Cambridge University Press. Available at: http://www.grida.no/publications/other/ipcc_tar/?src=/climate/ipcc_tar/wg1/212.htm.

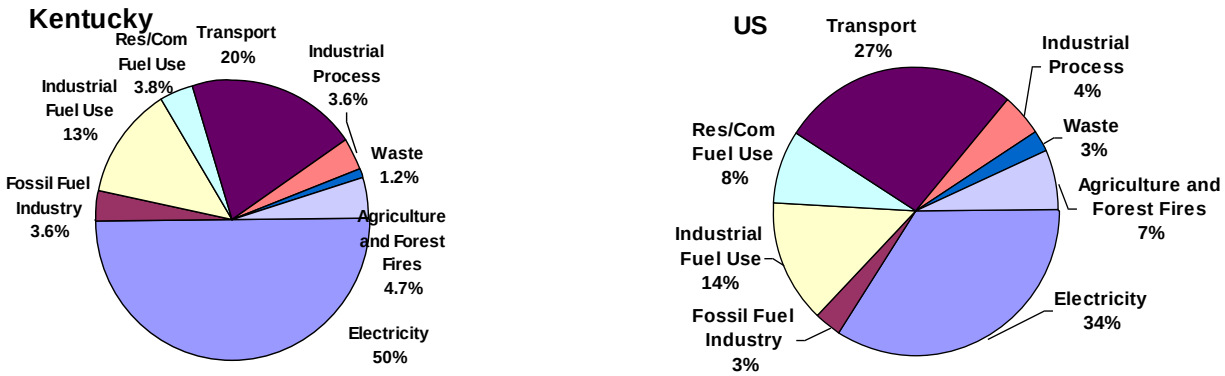
The inventory and reference case projections of Kentucky's GHG emissions provided the following critical findings:

- The principal sources of Kentucky's GHG emissions are electricity consumption, transportation, and RCI fuel use, accounting for 50%, 20%, and 17% of Kentucky's gross GHG emissions in 2005, respectively.
- Estimates of carbon sinks within Kentucky's forests and soils, including urban forests, land-use changes, and agricultural soil cultivation practices, are included in this report. The current estimates indicate that about 7.6 $MMtCO_2e$ of emissions were stored in Kentucky biomass in 2005. This leads to net emissions of about 176 $MMtCO_2e$ in Kentucky in 2005, an amount equal to 2.8% of total U.S. net GHG emissions.
- The use of coal has led to low electricity rates in Kentucky compared to the rest of the country, which has allowed energy-intensive industries that provide valuable goods and services beyond the borders of Kentucky to flourish in the state, as acknowledged in Kentucky's Energy Plan.[3]

While Kentucky's estimated emissions growth rate presents challenges, it also provides major opportunities. Key choices regarding technologies and infrastructure can have a significant impact on emissions growth in Kentucky. The KCAPC's recommendations document the opportunities for the state to reduce its GHG emissions, while continuing its strong economic growth by being more energy efficient, using more renewable energy sources, and increasing the use of cleaner transportation modes, technologies, and fuels.

Figure ExO-2 depicts a comparison between the sectoral components of GHG emissions in 2005 in Kentucky compared to the United States at large. Kentucky's electricity supply and transportation are projected to have the highest growth over the forecasted period.

Figure ExO-2. Gross GHG Emissions by Sector, 2005: Kentucky and U.S.



[3] Governor Steven L. Beshear, *Intelligent Energy Choices for Kentucky's Future: Kentucky's 7-Point Strategy for Energy Independence*, November 2008.

Notes: Res/Com = residential and commercial fuel use sectors; emissions for the residential, commercial, and industrial fuel use sectors are associated with the direct use of fuels (natural gas, petroleum, coal, and wood) to provide space heating, water heating, process heating, cooking, and other energy end-uses. The commercial sector accounts for emissions associated with the direct use of fuels by, for example, hospitals, schools, government buildings (local, county, and state), and other commercial establishments. The industrial processes sector accounts for emissions associated with manufacturing, and excludes emissions included in the industrial fuel use sector. The transportation sector accounts for emissions associated with fuel consumption by all on-road and non-highway vehicles. Non-highway vehicles include jet aircraft, gasoline-fueled piston aircraft, railway locomotives, boats, and ships. Emissions from non-highway agricultural and construction equipment are included in the industrial sector. Electricity is electricity generation sector emissions on a consumption basis (including emissions associated with electricity imported from outside of Kentucky and excluding emissions associated with electricity exported from Kentucky to other states and regions).

Recent Actions

GHG Reductions Associated with Recent Federal and State Actions

The KCAPC identified recent federal and state actions undertaken in Kentucky that will reduce GHG emissions while conserving energy and promoting the development and use of renewable energy sources. The resultant emission reductions are presented below. The total GHG reductions from recent federal and state actions is projected to be about 9.4 $MMtCO_2e$ in 2030, or a 3.8 % reduction from the business-as-usual (BAU) emissions in 2030 for all sectors combined. These GHG emission reductions are summarized in Figure ExO-3.

Recent Federal Actions

The federal Energy Independence and Security Act of 2007 was signed into law in December 2007. This law contains several requirements that will reduce GHG emissions as they are implemented over the next few years. During the KCAPC process, sufficient information was identified (e.g., implementation schedules) to estimate GHG emission reductions associated with implementing the federal Corporate Average Fuel Economy requirements. The GHG emission reductions projected to be achieved by these actions are also shown in Figure ExO-3. Together, these federal requirements are estimated to reduce gross GHG emissions for all sectors combined in Kentucky by about 4.02 $MMtCO_2e$ (a 1.8% reduction) from the BAU emissions in 2020, and by about 6.23 $MMtCO_2e$ (a 2.5% reduction) from the BAU emissions in 2030.

Recent State Actions

Kentucky has recently embarked on statewide energy efficiency programs in response to concerns about energy costs. Two existing state programs have also been included as recent actions. The Kentucky existing electric utility demand-side management actions are projected to yield reductions of 1.7 $MMtCO_2e$ in 2030, and the Kentucky Government Green Buildings program (House Bill 2) is projected to yield an additional 1.5 $MMtCO_2e$ of reductions in 2030.

KCAPC Policy Recommendations (Beyond Recent Actions)

The KCAPC recommended 46 policy actions. To amplify, Figure ExO-3 presents a graphical summary of the potential cumulative emission reductions associated with the recent federal and state actions and the 33 quantified policy recommendations relative to the BAU reference case projections. Table ExO-1 provides the numeric estimates underlying Figure ExO-3. In Figure ExO-3:

- The red line shows actual (for 1990, 1995, 2000, and 2005) and projected (for 2010, 2015, 2020, 2025 and 2030) levels of Kentucky's gross GHG emissions on a consumption basis. (The consumption-based approach accounts for emissions associated with the generation of electricity in Kentucky to meet the state's demand for electricity.) The red line for 2010–2030 includes projected emissions associated with recent federal and state actions that were analyzed quantitatively.
- The black line with blue diamonds portrays the reference case projections for 2010–2030 if no recent actions or additional policy options were enacted—the BAU scenario.
- The green line shows the projected GHG emission levels associated with the KCAPC's recommendation for Kentucky to adopt a statewide, economy-wide GHG reduction goal to reduce the state's gross GHG emissions by 20% below 1990 levels by 2030. Together, if the 33 quantified policy recommendations and the recent federal and state actions (or their equivalent) are successfully implemented, the 2030 emission reduction goal would be virtually achieved, based on results of analysis of KCAPC proposals conducted through the KCAPC and TWG process.

Figure ExO-3. Annual GHG Emissions: Reference Case Projections and KCAPC Recommendations (Consumption Basis, Gross Emissions)

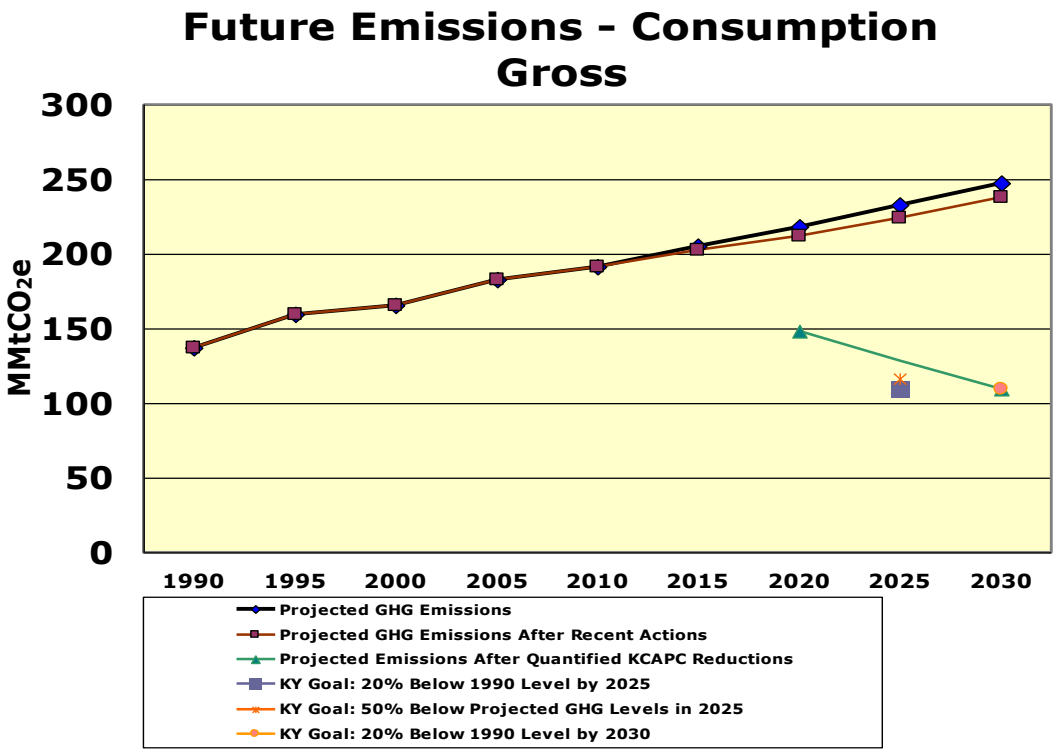


Table ExO-1. Annual Emissions: Reference Case Projections and Impact of KCAPC Options (Consumption Basis, Gross Emissions)

Annual Emissions ($MMtCO_2e$)	1990	1995	2000	2005	2010	2015	2020	2025	2030
Projected GHG Emissions	136.7	159.3	165.9	183.1	191.6	205.1	217.7	232.3	247.7
Reductions from Recent Actions	0.0	0.0	0.0	0.0	0.1	2.4	5.5	7.9	9.4
Projected GHG Emissions after Recent Actions	136.7	159.3	165.9	183.1	191.5	202.7	212.2	224.4	238.3
Total GHG Reductions from KCACP Recommended Policies	0.0	0.0	0.0	0.0	0.0	0.0	63.7	96.1	128.4
Projected Annual Emissions after Quantified KCAPC Reductions*							148.5	128.3	109.9
Kentucky GHG Reduction Goal: 20% below 1990 Level by 2030									109.4

*Projected annual emissions also include reductions from recent actions.

Table ExO-2 depicts a cumulative summary by sector of the policy recommendations and the estimated GHG reductions and costs/savings of implementing the KCAPC-recommended policies, after being adjusted for overlaps. Positive cost figures ($) indicate costs; negative cost (–$) figures indicate cost savings. For example, in Table ExO-2 the TLU Cost-Effectiveness estimate of (–$126/ tCO_2e) portrays a cost savings of $126 per metric ton of CO_2e. For the policies recommended by the KCAPC to yield the levels of estimated emission reductions shown, they must be implemented in a timely, aggressive, and thorough manner.

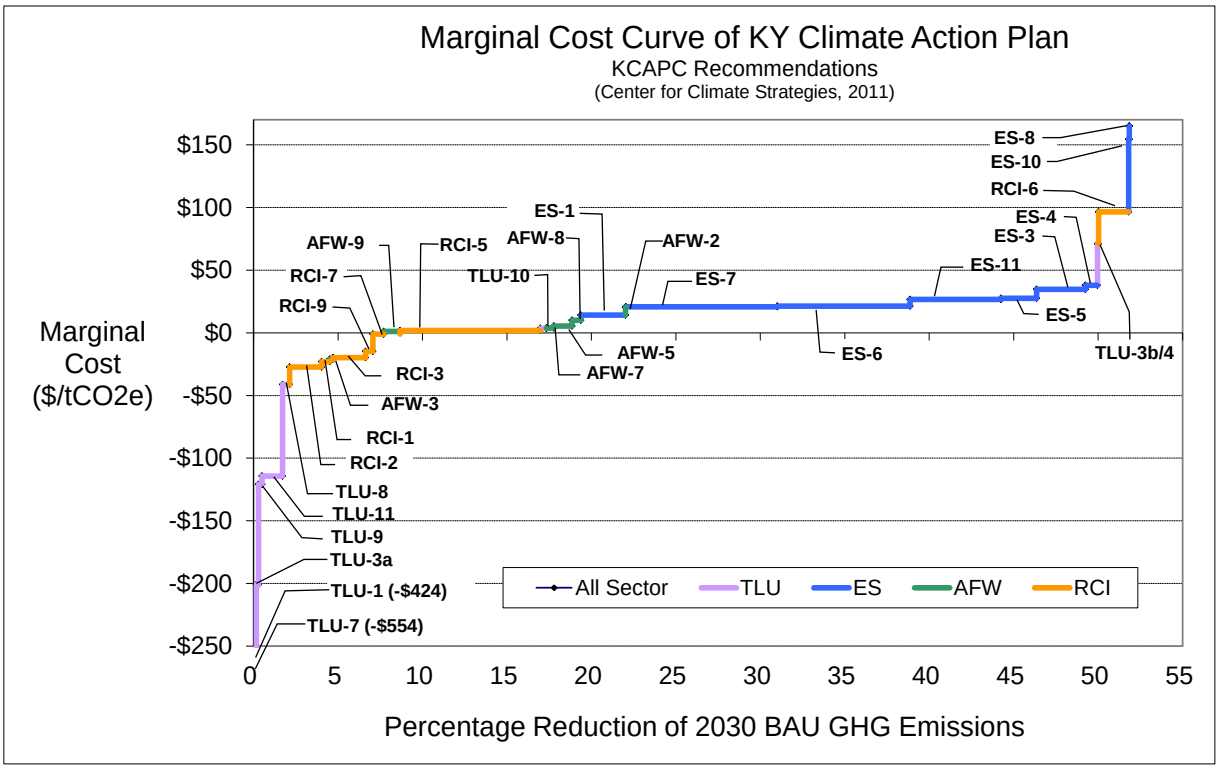
Table ExO-2. Summary by Sector of Estimated Impacts of Implementing All of the KCAPC Recommended Options (Cumulative Reductions and Costs/Savings)

Sector	GHG Reductions ($MMtCO_2e$)			Net Present Value 2011–2030 (Million $)	Cost-Effectiveness ($/tCO_2e$)
	2020	2030	Total 2011–2030		
Residential, Commercial, and Industrial (RCI)	19.1	38.3	408.2	$1,220	$3
Energy Supply (ES)	37.4	75.8	755.9	$17,911	$24
Transportation and Land Use (TLU)	2.8	6.3	62.4	–$7,877	–$126
Agriculture, Forestry, and Waste Management (AFW)	4.4	7.9	89.7	$308	$3.4
Cross-Cutting Issues (CCI)	Non-quantified, enabling options				
TOTAL (includes all adjustments for overlaps)	**63.7**	**128.3**	**1,316.2**	**$11,562**	**$8.8**

The values in this table do not include the effects of recent actions. Negative values in the Net Present Value and the Cost-Effectiveness columns represent net cost savings associated with the policy recommendations. Within each sector, values have been adjusted to eliminate double counting for policies or elements of policies that overlap.

Figure ExO-4 presents a step-wise marginal cost curve for Kentucky. The horizontal (x) axis represents the percentage of GHG emission reductions in 2030 for each policy recommendation relative to the BAU forecast. The vertical axis represents the marginal cost of mitigation (expressed as the cost-effectiveness of each policy recommendation on a cumulative basis, 2011–2030). In this figure, each horizontal segment represents an individual policy. The width of the segment indicates the GHG emission reduction potential of the recommendation in percentage terms. The height of the segment relative to the vertical axis shows the average cost (or saving) of reducing 1 tCO_2e of GHG emissions with the application of the recommendation. It is important to note that some of the policy options with an estimated cost savings still are likely to require significant up-front investments.

Figure ExO-4. Step-wise Marginal Cost Curve for Kentucky, 2030



Note: Results have been adjusted to remove overlaps between policies.

TLU-7 Parking Management and Ride Sharing; **TLU-1** Bicycle and Pedestrian Infrastructure Development; **TLU-3a** Transportation System Management; **TLU-9** Promote Locally Produced Goods and Services; **TLU-11** Promote Clean Vehicles; **TLU-8** Move Freight More Efficiently; **RCI-2** Move Beyond Code to Increase Building Efficiency; **RCI-1** Improve Building Codes and Related Training and Enforcement; **AFW-3** On-Farm Energy Efficiency Improvements; **RCI-3** Expand Utility DSM Programs; **RCI-9** Building Commissioning; Energy Tracking, Benchmarking; Building Labeling; **RCI-7** Lead by Example with Efficient Government Buildings; **AFW-9** Landfill Methane Energy Programs; **RCI-5** Financing Programs and Incentives for Efficiency and Combined Heat and Power; **TLU-10** Promote Alternative Transportation Fuels; **AFW-7** Reforestation, Afforestation and Restoration of Mined and Other Lands; **AFW-5** Soil Carbon Management; **AFW-8** Municipal Solid Waste Reuse, Recycling and Organic Waste Management; **ES-1** Biomass and Efficiency Improvements at Existing Power Plants; **AFW-2** Expanded Use of Biomass for Electricity, Heat, and Steam; **ES-7** Renewable Portfolio Standard; **ES-6** Nuclear Energy Capacity; **ES-11** Smart Grid Efficiency; **ES-5** Pricing Strategies to Promote Efficiency and Renewables (Feed-in-Tariff); **ES-3** Support for Advanced Fossil Fuels (IGCC, CCSR); **ES-4** CCSR Enabling Policies with Enhanced Oil Recovery; **TLU-3b/4** Transit Management and Infrastructure; **RCI-6** Financing, Incentives, Policies and Research for Conversion to Renewables; **ES-10** Shale Gas Development and Gas-to-Liquids Technology; **ES-8** Technology Research and Development.